

***SICYOPUS (SMILOSICYOPUS) CHLOE*,
A NEW SPECIES OF FRESHWATER GOBY
FROM NEW CALEDONIA (SICYDIINAE)**

by

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ABSTRACT. *Sicyopus (Smilosicyopus) chloe* n. sp., a carnivorous freshwater goby, is described on the basis of 22 specimens collected from high gradient streams on the eastern coast of North Province, New Caledonia. It differs from most *Sicyopus* species in having canine teeth in both upper and lower jaws, and the absence of labial teeth projecting horizontally from the lower jaw. It differs from other species of the subgenus *Smilosicyopus* by a combination of characters that include 4-7 blackish spots on each side of nape, a broad blackish V-shaped mark ventrally on head being most prominent in males, 14-16 scales in zigzag series and strongly differentiated sexually dichromatism colour patterns. All other species of *Sicyopus (Smilosicyopus)* have sexual dichromatism poorly developed with males being only slightly more dusky than females.

RÉSUMÉ. *Sicyopus (Smilosicyopus) chloe*, une nouvelle espèce de gobie d'eau douce de Nouvelle-Calédonie (Sicydiinae).

Sicyopus (Smilosicyopus) chloe n. sp., un gobie carnivore dulçaquicole, est décrit à partir de 22 exemplaires collectés dans les rivières de la côte Est de la Province Nord de la Nouvelle-Calédonie. Il diffère de la plupart des autres espèces de *Sicyopus* par la présence de dents caniniformes sur les mâchoires supérieure et inférieure et par l'absence de dents labiales horizontales sur la mâchoire inférieure. Il diffère des autres espèces du sous-genre *Smilosicyopus* par plusieurs caractères dont la présence de 4 à 7 points noirs sur chaque côté de la nuque, une marque formant un V noirâtre sur la partie ventrale de la tête et bien marquée chez les mâles, 14 à 16 écailles disposées en zigzag, ainsi qu'un fort dichroïsme sexuel. Les autres espèces de *Sicyopus (Smilosicyopus)* ont en effet un dichroïsme sexuel peu développé, les mâles étant seulement légèrement plus sombres que les femelles.

Key words. Gobioidae - Sicydiinae - *Sicyopus chloe* - New Caledonia - Freshwater - New species.

During the past 25 years many freshwater gobies, including those of the subfamily Sicydiinae Gill, 1860, usually considered to belong to Gobiidae, have been collected and identified from freshwater streams throughout the tropical Indo-Pacific. With this new material the status of some species has been resolved, like *Lentipes concolor* (Gill, 1860), which is known now as endemic from the Hawaiian Islands (Maciolek, 1978) and approximately 40 new species of Sicydiinae have been described from the Pacific region since 1979. Although many new species have been described in the past 20 years, at least 40 more freshwater gobies belonging to the Sicydiinae await description.

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From an insular standpoint the freshwater ichthyofauna of New Caledonia is both rich and varied (Jouan, 1861, 1863, 1877; Castelnau, 1873; Ogilby, 1897; Weber and de Beaufort, 1915; Catala, 1950; Dingerkus and Séret, 1992a, 1992b; Séret, 1992; Séret and Dingerkus, 1992; Séret, 1997; Marquet and Mary, 1999; Mary, 1999; Keith *et al.*, 2000). The Sicydiinae from New Caledonia includes five nominal and valid species: *Sicyopterus sarasini* Weber & de Beaufort, 1915, an endemic; *Sicyopterus lagocephalus* (Pallas, 1774) distributed from the Comoro and Mascarene Islands in the western Indian Ocean to the Society Islands in French Polynesia; *Sicyopus* (*Sicyopus*) *zosterophorum* (Bleeker, 1857) distributed from the eastern Indian Ocean of Indonesia to Japan and New Caledonia; *Stiphodon atratus* Watson, 1996 and *Stiphodon rutilaureus* Watson, 1996, distributed from eastern Indonesia to New Caledonia. Additionally, there are six new species of Sicydiinae: one of *Lentipes* Günther, 1861, one of *Sicyopus* Gill, 1863, at least three of *Stiphodon* Weber, 1895, and another species of an undetermined genus.

Watson (1999) recently defined three subgenera as belonging to *Sicyopus* Gill, 1863: *Juxtastiphodon*, *Smilosicyopus* and *Sicyopus*. It has been suggested that *Smilosicyopus* is a junior synonym of *Raogobius* Mukerji, 1935 (Kottelat, pers. comm., 1999), based on a single specimen (CMK 14795) collected from the Andaman Islands, but this problem requires study.

The purpose of the current research is to provide a description of *Sicyopus* (*Smilosicyopus*) *chloe* n. sp., a freshwater goby found only in New Caledonia.

METHODS

Methods follow Watson (1995). Measurements were taken with a dial caliper to the nearest tenth of a millimeter. All counts were taken from the right side. The size is given in standard length (SL). Teeth were counted to the right of symphysis. Abbreviations for institutions and collections cited follow Leviton *et al.* (1985), except LICPP, which is now BLIH (Biological Laboratory, Imperial Household, Akasaka Imperial Palace, Tokyo) and CMK (Collection of Maurice Kottelat, Cornol, Switzerland). Abbreviations for the cephalic sensory pore system follow Akihito (1986).

Comparative material.—*Sicyopus* (*Smilosicyopus*) *bitaeniatus* Maugé *et al.*, 1992. Marquesas Islands: MNHN 1992-113, female (34.4 mm SL) and MNHN 1992-115, 2 males, 8 females (21.3–33.6 mm), Hiva Oa, Vaioa River, 7 Jan. 1987, G. Marquet coll.; MNHN 1992-114, 2 females, 1 unsexed (26.2–28.8 mm), Ua Pou, Paaumea River, 22 Dec. 1986, G. Marquet coll.

Sicyopus (*Smilosicyopus*) *fehlmanni* Parenti & Maciolek, 1993. Caroline Islands: Belau, Babelthuap Island, CAS-SU 52024, 13 males, 20 females, 1 juvenile (15.4–40.2 mm), south fork Arakitauch Stream, 2.2 km southeast of Ngarekeai village, 26 Nov. 1956, Sumang *et al.* coll.; CAS-SU 69693, 16 males, 29 females (18.9–33.4 mm), Ngardmau Municipality, north fork Amekaud River, 10 Oct. 1957, Sumang *et al.* coll.

Sicyopus (*Smilosicyopus*) *leprurus* Sakai & Nakamura, 1979. Japan: Ryukyu Islands, Okinawa Prefecture, Ishigaki Island, BLIH 1983170, 5 males, 1 female (31.9–41.4 mm), Ishigaki City, Ara River, 10 Jul. 1983; BLIH 1986407, male (30.5 mm), Ishigaki City, Ara River, 9 Sep. 1986; BLIH 1987587, female (31.8 mm), Ishigaki City, Ara River, 10 Oct. 1987; BLIH 1989135, male (29.5 mm), BLIH 1989136, female (33.2 mm), Ishigaki City, Ara River, 17 Oct. 1989; BLIH 1990727, female (30.1 mm), Ishigaki City, Ara River, 6 Oct. 1990; NSMT P.28619, 2 males, 2 females, Ishigaki Island, Arakawa River, 2 Sep. 1974; URM P4529, female (30.1 mm), 4 Sep. 1982.

Sicyopus (Smilosicyopus) sp. BPBM 37404, male (33.6mm) and BPBM 37405, 2 males, 4 females (17.4-31.5mm), Mariana Islands, Guam, Asmafinas River, May 1995, J. Parham and B. Tibbatts coll.

***SICYOPUS (SMILOSICYOPUS) CHLOE*, N. SP.**

Figs 1-3, Tables I-IV

Synonyms: *Sicyopus* sp. n.: Marquet *et al.*, 1997: 30.

Sicyopus sp.: Séret, 1997: 374.

Material examined

Twenty two specimens from eastern slope streams of the North Province, New Caledonia, totaling 8 males, 14 females, size range 21.2-42.5mm, largest male 40.4, largest female 42.5, smallest gravid female 27.9.

Holotype. MNHN 1996-262, male (33.9mm); Wé Tite, elevation 80m, 23 Sep. 1991, B. Séret coll., PEDCAL st. 36, t° 23°C, pH 8.3, conduct. 142µs.

Paratypes. BPBM 37406, female (32.4mm), Cascade de Tao, 9 Oct. 1996, G. Marquet coll.; MNHN 1996-263, male (31.6mm), same data as holotype; MNHN 2000-670, 2 females (25.9-34.3mm), Cascade de Tao, 3 Apr. 1999, Expédition Chloé I; SMF 28325, 2 females (26.8-32.3mm), Cascade de Tao, 14 Dec. 1996, G. Marquet coll.; MNHN 2000-671, male (40.4mm), Kokengoné river, 28 Oct. 1999, Expédition Chloé II; MNHN 2000-672, 3 males, 3 females (24.0-27.9mm), Tibarama river, station 3, 26 Oct. 1999, Expédition Chloé II; MNHN 2000-673, female (21.2mm), Naruma river, 26 Oct. 1999, Expédition Chloé II; MNHN 2000-674, 1 male, 4 females (23.1-42.5mm), tributary of Napouémien north of Napwéimié near Poindimié, 28 Oct. 1999, Expédition Chloé II; UF 112009, 1 male, 1 female (31.4-33.1mm), tributary of Napouémien north of Napwéimié near Poindimié, 4 Apr. 1999, Expédition Chloé I.

Table I. Number of upper jaw teeth in *Sicyopus chloe* and related species.

	Upper jaw teeth														
	12	13	14	15	16	17	18	19	20	21	22	23	24	25	
<i>S. chloe</i> males				1	1	2	1	-	-	1	2				
<i>S. chloe</i> females		1	4	1	3	4	1								
<i>S. bitaeniatus</i> males						1	-	-	-	-	1				
<i>S. bitaeniatus</i> females					3	1	1	3	1	2	-	-	-	1	
<i>S. fehlmanni</i> males		1	4	2	8	4	2	5	3	1					
<i>S. fehlmanni</i> females	1	5	8	11	12	5	7	2	4						
<i>S. leprurus</i> males		2	2	4	1	-	1								
<i>S. leprurus</i> females	1	-	1	-	3	2									
<i>Sicyopus</i> sp. males		1	-	-	1	-	1								
<i>Sicyopus</i> sp. females		1	1	-	1	1									

Table III. Scale counts in *Sicyopus chloe* and related species.

		Lateral series																																		
		12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46
<i>S. chloe</i>		1	-	1	1	2	2	2	3	-	3	-	-	-	-	1	-	1	1	-	1	-	-	-	-	-	1									
<i>S. bitaeniatus</i>																																				
<i>S. fehlmanni</i>				9	5	4	8	8	6	4	6	6	4	8	4	-	-	1	2	1	1	-	1	-	1	-	2	1	2	1	-	1	-	-	-	1
<i>S. leprurus</i>						1	2	2	1	-	1	5	1	-	-	-	-	1	-	1	-	-	-	-	1											
<i>Sicyopus</i> sp.							1	-	-	-	-	1	-	1	1	-	-	-	-	1	1	-	-	-	-	1										

		Transverse series back																						
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
<i>S. chloe</i>	20	-	-	1	1																			
<i>S. bitaeniatus</i>	15																							
<i>S. fehlmanni</i>	49	-	1	7	2	3	2	-	1	1	4	1	2	1	1	1	-	1	1	-	-	1	1	1
<i>S. leprurus</i>	16	-	-	-	-	-	1																	
<i>Sicyopus</i> sp.	7																							

		Transverse series forward										Zigzag series												
		0	1	2	3	4	5	6	7	8		9	10	11	12	13	14	15	16	17	18	19	20	21
<i>S. chloe</i>	21	-	-	-	1						<i>S. chloe</i>				1	2	6	3	6	2				
<i>S. bitaeniatus</i>	14										<i>S. bitaeniatus</i>													
<i>S. fehlmanni</i>	64	3	3	3	2	4					<i>S. fehlmanni</i>	2	15	16	26	12	8		2	6	1	3	-	1
<i>S. leprurus</i>	16	-	-	-	-	-	-	-	-	1	<i>S. leprurus</i>		1	1	2	3	6	3						
<i>Sicyopus</i> sp.	7										<i>Sicyopus</i> sp.				1	1	1	1	1	1	2			

Diagnosis

A *Sicyopus (Smilosicyopus)* species with the following set of characters: one or 2 canine teeth on each side of upper and lower jaws. Broad blackish 'V' shaped mark on head ventrally in males, appearing dusky in females. Nape with a row of 4 to 7 blackish spots in small individuals on each side, becoming more numerous on upper surface of head, snout and

Table III. Morphometrics in *Sicyopus chloe* and related species expressed to the nearest whole percent of standard length.

Predorsal length										
	33	34	35	36	37	38	39	40	41	42
<i>S. chloe</i>			2	3	9	2	5	-	1	
<i>S. bitaeniatus</i>				4	-	3	3	4		
<i>S. fehlmanni</i>			4	8	19	27	12	4	3	1
<i>S. leprurus</i>	1	-	2	1	11	2				
<i>Sicyopus</i> sp.			1	1	-	1	-	2	2	

Preanal length												
	54	55	56	57	58	59	60	61	62	63	64	65
<i>S. chloe</i> males						1	2	5				
<i>S. chloe</i> females						1	2	4	2	3	2	
<i>S. bitaeniatus</i> males					1	-	-	-	1			
<i>S. bitaeniatus</i> females					1	-	-	2	4	2	2	1
<i>S. fehlmanni</i> males		1	-	4	4	11	5	4				
<i>S. fehlmanni</i> females	1	-	-	2	1	8	6	13	15	2	1	
<i>Sicyopus</i> sp. males								2	1			
<i>Sicyopus</i> sp. females				1	1	1	-	-	1			

Head length							
	22	23	24	25	26	27	28
<i>S. chloe</i>		5	7	8	1	1	
<i>S. bitaeniatus</i>	1	1	5	1	4	1	1
<i>S. fehlmanni</i>	1	17	21	26	12	1	
<i>S. leprurus</i>	1	3	5	4	3	1	
<i>Sicyopus</i> sp.				1	5	-	1

Caudal peduncle length							
	16	17	18	19	20	21	22
<i>S. chloe</i>	1	1	2	3	11	2	2
<i>S. bitaeniatus</i>	1	5	6	-	1	-	1
<i>S. fehlmanni</i>		4	10	28	24	12	1
<i>S. leprurus</i>		1	4	6	5	1	
<i>Sicyopus</i> sp.		1	-	3	1	2	

Jaw length							
	7	8	9	10	11	12	
<i>S. chloe</i> males				4	2	2	
<i>S. chloe</i> females	6	5	3				
<i>S. bitaeniatus</i> males				2			
<i>S. bitaeniatus</i> females	1	3	4	4			
<i>S. fehlmanni</i> males		8	19	2	1		
<i>S. fehlmanni</i> females	13	31	6				
<i>S. leprurus</i> males		1	2	1	2	4	
<i>S. leprurus</i> females	5	2					
<i>Sicyopus</i> sp. males			2	1			
<i>Sicyopus</i> sp. females		2	2				

Caudal peduncle depth				
	7	8	9	10
<i>S. chloe</i>		2	11	9
<i>S. bitaeniatus</i>	1	3	10	
<i>S. fehlmanni</i>	4	19	39	17
<i>S. leprurus</i>			10	7
<i>Sicyopus</i> sp.		1	3	3

Body depth at second dorsal fin origin in males			
	9	10	11
<i>S. chloe</i>		2	2
<i>S. bitaeniatus</i>			1
<i>S. fehlmanni</i>	2	12	11
<i>S. leprurus</i>	1	3	5
<i>Sicyopus</i> sp.		1	2

on upper opercle in larger specimens. Markings sexually dimorphic, males dorsal to midline blackish with a row of whitish spots or irregular barring and ventral to midline whitish, females with broad dusky bars laterally, being blackish midlaterally.

Description

Number of upper jaw teeth in *S. thloe* and related species are given in table III, scale counts in table III, morphometrics in table III and fin length in Table IV. Below, the holotype counts are given first followed, in brackets, by the paratypes counts.

Dorsal fins (D) D VI-I, 9 (VI-I, 7 (1), VI-I, 9 (20)), spines 3-6 slightly filamentous in males and not in females, first dorsal fin not contacting second dorsal fin basally, one specimen with 7 segmented rays in second dorsal fin with a broad gap between rays 4 and 5 where two additional rays would normally occur. Anal fin (A) I, 10 (I, 10 (21)). Pectoral fin (P) rays 14 (13-15), posterior margin rounded. Caudal fin (C) 13 (12 (6), 13 (9), 14 (5)) branched rays, posterior margin rounded. Pelvic disc (V) with 1 spine and 5 strongly branched rays, disc adherent to abdomen between fifth rays only. Scales in lateral series (LS) 17 (12-37) (Table III), may extend midlaterally to origin of second dorsal fin and posteriorly to hypural base, scales usually cycloid, scales along dorsum usually extend anteriorly along medial base of second dorsal fin (may extend to posterior base of first dorsal fin). Scales in zigzag series (ZZ) 16 (14-16) (Table III). Predorsal midline, head, breast, belly, pectoral base, and trunk naked. Upper jaw teeth mostly conical (range 13-21), 1 or 2 canines present laterally except in small specimens, females modally with fewer teeth than males. Lower jaw teeth conical (range 11-17), single canine tooth usually present laterally (1-2) except in small specimens, females modally with fewer teeth than males (Table III). Rakers on inner edge of outer gill arch 0-1+0-1+1-3, rakers present as short, papillae-like projections without ossification. Cephalic sensory pore system A, B, C, D, F, H, K, L, M and O, D singular, with all others paired, oculoscapular canal separated into anterior and posterior canals between pores H and K (Fig. 1). Cutaneous sensory papillae well developed over head and present between pores H and K. Figure 2 gives the diagrammatic illustration of urogenital papilla. Urogenital papilla in male long with a fairly rounded tip. Urogenital papilla in female somewhat triangular in appearance with distal tip fimbriate.

Colour in preservation

Sexual dichromatism well developed.

Males. Background of head and body creamy. Body blackish dorsal to midline, with 5 or 6 white spots or blotchy bars, along bases of both dorsal fins and caudal peduncle blackish, body ventral to midline whitish. Blackish band posterior to eye and dorsal to pectoral base. Nape grayish with 4 to 7 blackish spots on each side in smaller males, with larger males having spots covering head dorsally to include upper opercle, may be a blotchy band medially, or numerous small black spots, between orbit in males that may extend anteriorly to between anterior nostrils. From tip of snout and upper lip a blackish band extending to posterior edge of opercle. Snout dusky, may have numerous small spots or few larger spots. Branchiostegal rays and membrane with a distinctively blackish V-shaped marking ventrally. First and second dorsal fins slightly dusky with blackish spots, having some streaking prominent on membrane, distal margin slightly dusky. Caudal fin with blackish medial band from base extending to posterior edge, dorsal to medial band mostly dusky with clear margin, ventrally clear. Anal fin clear basally becoming slightly dusky distally with blackish margin. Pelvic disc clear with some dusky pigment. Pectoral fin with blackish band medially becoming slightly dusky dis-

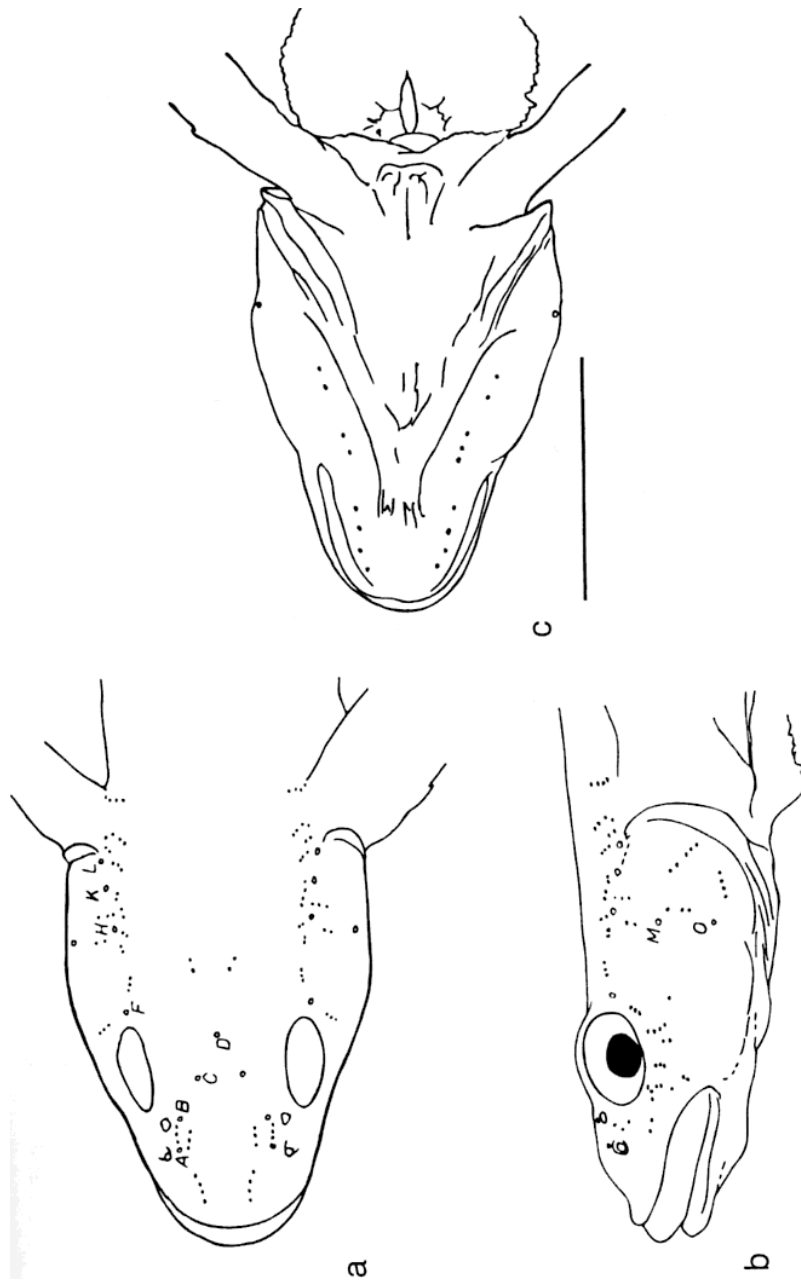


Fig. 1. Diagrammatic illustration of the head in *Sicyopus chloe* (MNHN 2000-671) showing head pores and sensory papillae. **a**: Dorsal view; **b**: Lateral view; **c**: Ventral view. Scale bar 0.5 mm.

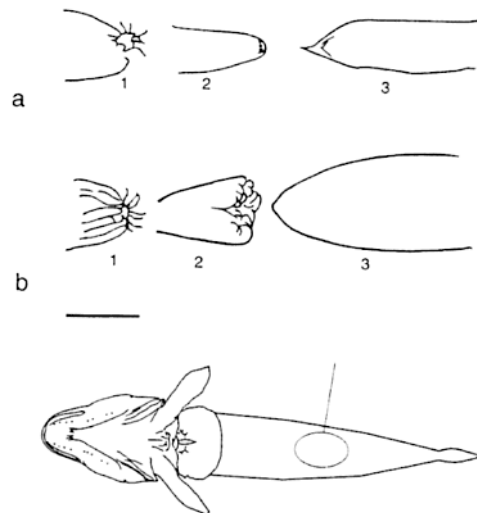


Fig. 3. Diagrammatic illustration of the urogenital papilla (ventral view) in *Sicyopus chloe*. **a**: Male (MNHN 2000-671); **b**: Female (UF 112009). 1: anus; 2: urogenital papilla; 3: anal fin. Scale bars 0.5 mm.

tally, ventrally and dorsally mostly without pigment. Pectoral base blackish medially, slightly dusky dorsally and ventrally.

Females. Background of head and body whitish, laterally with evenly spaced dusky bars becoming blackish midlaterally. Four dusky saddles along base of second dorsal fin and caudal peduncle. First dorsal fin dusky. Nape slightly dusky with 4 or more blackish spots on each side, anterior to first dorsal fin a short blackish band. Background of head whitish, a blackish medially bar from tip of snout and upper lip to posterior edge of opercle, dorsally dusky, ventrally slightly dusky. Ventrally head mostly without pigment, branchiostegal membrane and rays with a dusky V-shaped marking, indistinct in most specimens. Some black subcutaneous pigment present along edge of lower jaw. Blackish pigment present at base of gular region. First and second dorsal fins slightly dusky with short blackish bars on spines. Caudal fin with a blackish C-shaped mark over much of surface. Anal fin with rays and spine mostly without pigment, membrane clear. Pelvic disc clear. Pectoral fin rays dusky, a blackish blotch medially. Pectoral base slightly dusky with a blackish bar medially.

Colour in life

Males (Fig. 3a). Dorsal fins distally and caudal fin dorsally and ventrally yellow. Midline of head and body yellowish to russet. Pectoral fin russet ventrally. Distal margin of anal fin bluish. Pelvic disc russet.

Females (Fig. 3b). Dorsal fins distally yellowish or slightly russet. Laterally body and head may appear russet. Pectoral fin may be yellowish. Caudal fin may be yellowish dorsally and ventrally. Belly bright red in gravid material.

Distribution

Known only from North Province, New Caledonia in eastern slope streams of Mont Panié.

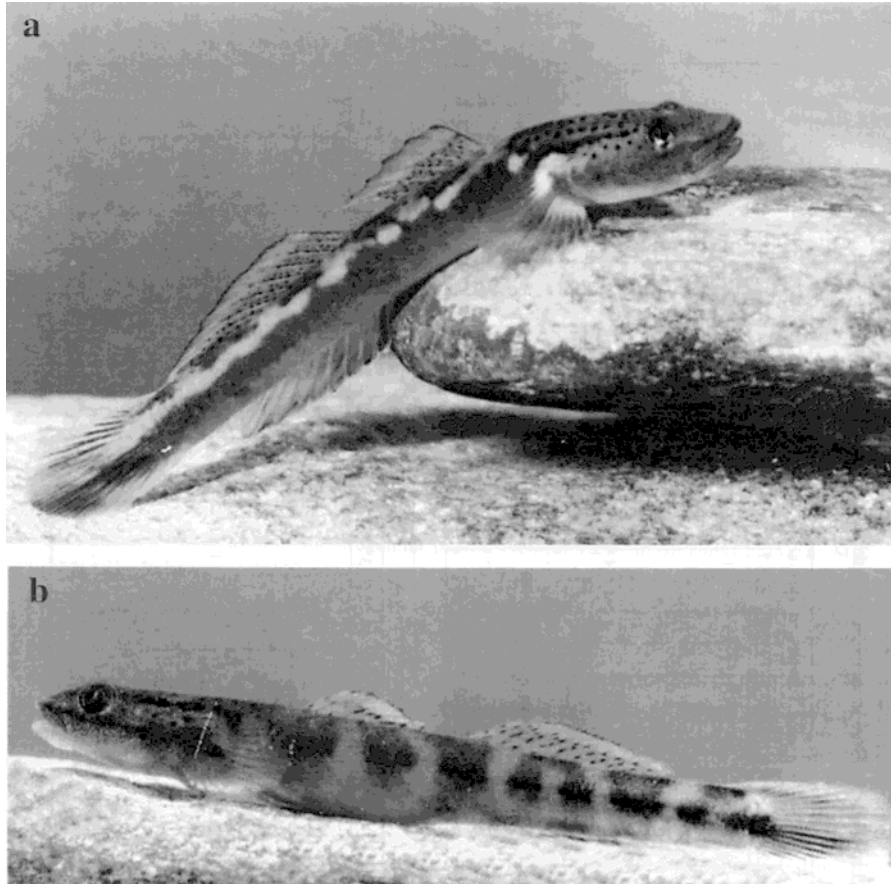


Fig. 3.3. *Sicyopus chloe*, New Caledonia. **a**: MNHN 2000-671, paratype, male, 40.4 mm SL, Kokengoné river (photo by É. Vigneux, MNHN/CSP-Chloé II); **b**: UF 112009, paratype, female, 31.4 mm SL, Napwéimié river (photo by É. Vigneux, MNHN/CSP-Chloé I).

Ecology

Like most Sicydiinae, *Sicyopus chloe* is found in clear, high gradient streams with rocky bottom. Typical of other members of *Sicyopus* it is strictly carnivorous (aquatic insects and crustaceans).

Comparisons

Smilosicyopus differs from all others sicydiine gobies in having well developed canine teeth in upper and lower jaws, pronounced in males. This subgenus is known from eastern Indonesia to the Marquesas islands and southern Japan to New Caledonia in swift clear, high gradient streams with rocky and boulder strewn bottoms. *Smilosicyopus* currently includes 5 species (*S. bitaeniatus* Maugé *et al.*, 1992; *S. phlmanni* Parenti & Maciolek, 1993; *S. prurus* Sakai & Nakamura, 1979; *S. chloe* n. sp.; *Sicyopus* sp.), although recent collection from the tropical Indo-Pacific indicate there exists more species (Watson, unpublished datas).

The conspicuous spots on the nape suggest *S. chloe* may be close to *S. phlmanni*, and

differs substantially from *S. tetrurus* and *Sicyopus* sp., especially with regards to colouration (head and body yellowish to russet in males). Lateral markings on females resemble patterns found on *S. taiteniatus*, but are different from those of *S. tetrurus* and *Sicyopus* sp. *Sicyopus chloe* is separated from congeners in having canine teeth in both upper and lower jaws, and the absence of labial teeth projecting horizontally from the lower jaw. It differs from other species of the subgenus *Smilosicyopus* by a combination of characteristics that include 4-7 blackish spots on each side of nape, a broad blackish V-shaped mark ventrally on head being most prominent in males, 14-16 scales in zigzag series and strongly differentiated sexual dichromatic colouration in preservation and well developed colours in life. In all other species of the subgenus *Smilosicyopus* colours are usually tannish with dusky markings with only females having any bright colour, the bright red belly when gravid.

Etymology

The name for the new species (*chloe*) is derived from Chloé, the name of recent expeditions (Chloé Expéditions I and II) to New Caledonia during which most specimens utilised in the description of the new species were collected. The new name is treated as a noun in apposition.

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